Northern Rockies Area, Fires 2000 and Historical Large Fires

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This report supplements one prepared by Richard C. Rotherrmel: "A Perspective on Large Fire in Montana—What can be expected in the remainder of 2000?" Our objective was not to do specific projections of ongoing fires, but rather to give analysts an historical perspective as they consider potential growth of those fires. We describe what has happened on extreme fires of the past.

Attached are

1) Brief descriptions of several fires and fire complexes: 1910 Fires, Tillamook Burn 1933, Sundance Fire 1967, Canyon Creek Fire 1988, Yellowstone Fires 1988. In the interest of timely completion of this report, very little is written about the 1988 fires, which are fresh in our minds. Information on the Tillamook Burn in included because it follows the same pattern although in burned under different weather influences.
2) Graphs that show daily fire growth and cumulative total area. Of note are the large runs.
3) A table summarizes the size and date of those runs.
4) Maps of the Sundance Fire, Canyon Creek Fire, and a selected 1910 fire copied so that they are at the same scale for comparison of size.
5) A map of the 1910 fires.

Information on the 1910 Fires, Sundance Fire, and the Tillamook Fire was taken, often verbatim, from a report prepared by Steve Pyne and Phil Omi. (Wildland fires and nuclear winters—Selected reconstructions of historic large fires. Technical Report prepared for the Defense Nuclear Agency. DNA-TR-85-396. 162 p. 1986.)

> For the United States the historic record documents fire complexes on the order of the 1910 fires for Main-New Brunswick (Miramichi Fire, 1825), coastal North Carolina (1898), interior Alaska (1957), and possibly the Lake States (1871). Other large complexes, on the order of 0.4 million hectares (1 million acres) have occurred in the Pacific Northwest (1902), the Lake States (1881), Alaska (frequently), and possibly the Northeast (1903). In all cases the fires involved the conflation of drought, multiple ignitions, persistent combustion, and outbreaks of critical fire weather. Except in the case of Alaska, disturbed fuels—logging and land clearing—were a contributing cause. In all instances these vast fire complexes were composites of numerous fires, many of which were themselves amalgamations of smaller fires that may or may not have been dynamically related. The 1910 fire conforms to this scenario. Fuels

> disturbed by anthropogenic ignitions were probably more critical in the evolution of the overall complex.

They used the Sundance Fire in describing the 1910 fires.

> Each region of the U.S. displays an archetypal large fire pattern such that every large fire in that region, while differing in the size of its burned area, reveals roughly the same fire behavior traits and occurs under similar environmental conditions. The 1910 fires burned under similar circumstances and with similar effects to the intensively studied Sundance Fire of 1967 (Idaho). By making judicious extrapolations from the behavior and characteristics of the Sundance Fire to the 1910 fire complex, we (Pyne and Omi) believe we can reconstruct the most important parameters of fire behavior and smoke production.
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> In a number of ways the Sundance fire had characteristics of the 1910 fire complex. It shared the same geometry, experienced similar meteorological conditions, burned analogous fuels, and resembled the old fires in behavior and effects. The fires that comprised the 1910 complex and the Sundance Fire conformed to the archetype of a large fire in the Northern Rockies. Accounts of the two episodes agree, photos of smoke columns and blow downs from each show a plausible similarity, terrain and fuel types are closely similar, diffuse synoptic conditions are analogous, patterns of fire growth and mechanisms of fire propagation show a strong resemblance, and considerations of scale do not seem to exist that would translate into different fire phenomenology. Conditions in 1910 were more prolonged, more intense, and more widespread. In place of single fire, there were scores, some of which had already reached large dimensions by the time of the "Big Blowup."
>
> There is an important matter of scale. There is no evidence to suggest that the fires of the 1910 complex interacted in such a way that introduced new kinds of fire behavior. Mergers undoubtedly occurred, although a proportion of these involved backfires set by firefighters. This confluence of fires, while spectacular, was transient and local. And while the 1910 fires burned an unusually vast area, the proportion of the region under flame at any one time was much less than the total burned area. If one considers only the active flaming fronts, the area under fire is further diminished.

We (Rothermel and Andrews) use the Sundance Fire and the Canyon Creek Fire to suggest fire growth that could occur on the 2000 fires under similar extreme wind events.

Fire / Complex	Dates	Total acres	Fire Run				Fire ending event
			Date	Acres	% total size	Spread distance and time	
1910 Fires (MT – ID)	7/23 – 8/31 1910	3,530,000	Aug. 20-21 (36 hours)	2,650,000	75%	30-50 mi in 36 hours	Light rain and snow on Aug. 23 Drenching rain on Aug. 31
Sundance Fire	8/23 – 9/1 1967	59,092	Sept. 1 (9 hours)	53,105	90%	16 mi in 9 hours	Less fuel, reduced wind, Higher RH
Canyon Creek Fire	7/11 – 9/10 1988	188,071	Sept. 6-7	117,330	62%	21 mi in 5.5 hours	Snow on Oct. 14
Yellowstone Fires	6/30 – 9/30 1988	1,688,256	Aug. 20 Aug.29-30 Sept.6-10	152,959 172,244 614,619	9% 10% 36%		Snow on Sept. 10
Tillamook Burn (Oregon)	8/13 – 8/27 1933	267,093	Aug. 25-26	200,155	75%		Rain Aug. 27, 28, 29

Extreme fire spread rate can be 2-4 mi/h.
(16 mi in 9 hrs = 1.8 mi/h; 21 mi in 5.5 hrs = 3.8 mi/h)

Fires were wind-driven with long range spotting

The major fire runs occurred late in the year.

A large part of the final fire size was a result of a major run.

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1910 Fires

During the summer of 1910 a great drought gripped the northern and western states, and wildland fires steadily increased in number and intensity. Nearly 1.43 million hectares (3.53 million acres) burned on national forest lands that summer in northern Idaho and western Montana. Although fires often smoldered for months in the backcountry, occasionally flaring into activity, most of the burning occurred during a 36 hour period between August 20 and 21 under the influence of gale force out of the southwest. Although there were 1,736 fires, most of the burned area was the result of perhaps 50 fires, of which probably 9 exceeded 81,000 hectares (200,155 acres) each. Ten fires accounted for 930,000 hectares (2.3 million acres), or 66% of the total.

The phenomenal spread rates reported for the 1910 fires (20 to 70 miles per hour) almost certainly reflect the effects of long-range spotting. The 1910 fires were wind-driven. The smoke plume, while enormous, spread rapidly and apparently dissipated quickly. The large fires achieved their dimensions because they began large and were subjected to a series of dry winds, probably associated with the passage of cold fronts.

The drought that led up to the 1910 fires did not become apparent until April. Not a dry winter but a dry spring initiated the record precipitation deficit. Virtually no rain fell from April until the end of August. Thunderstorms brought dry lightning, not rain. Incendiary fires—many of them set by drifters and laid-off workers who hoped to be hired as firefighters—broke out along roads and tracks and invaded fresh logging slash. Other fires were set by sparks from railroads. By mid-July some 3000 fires, including 90 "large" fires, had been attacked and more or less controlled.

On July 23, a severe dry lightning storm started probably hundreds of fires throughout the Northern Rockies, many of them in remote areas for which detection and control were practically impossible.

On August 9 Forest Service officials announced that the worst seemed to be over.

On August 10, a small "blowup" occurred, probably the outcome of a moisture surge from the southwest in conjunction with a rapidly moving cold front, winds, and lightning. New fires were ignited, and old ones enlarged. A number of remote fires crossed over the Bitterroot Range.

Because they began in accessible sites, the incendiary fires could be contained fairly easily. The price, however, was to commit most of the firefighting resources to these starts and to ignore others. In particular, the fire organization had to ignore more distant lightning-caused fires in the backcountry, some of which required days to discover and reach. These fires, in turn, flooded the

landscape with smoke, further decreasing the likelihood of their discovery at a time when they could be fought easily. The larger backcountry fires were uncontrolled and probably uncontrollable.

On August 19 officials looked forward to the end of the fire season, and the worst fires seemed to be at least contained. The next morning, August 20, "there was little wind noticeable and there was no premonition of the calamity about to occur" (recalled Roy Phillips). Puzzling over synoptic charts, fire weather forecaster Edward Beals noted that the weather map the day before gave no indication that the winds would be any stronger than they had been on the preceding days, and, in fact, the weather map on the morning of the fire did not show that any stronger winds should be expected than on several occasions during the last half of July and during the first part of August.

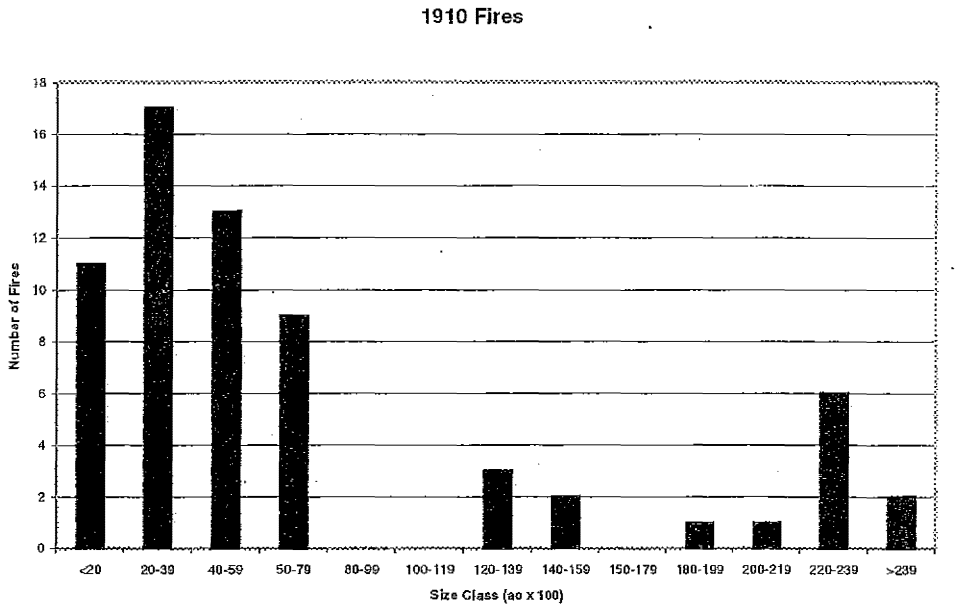
Around noon on August 20 the winds rose from the southwest. For nearly 36 hours the wind blew, fires expanded, merged, and spread across the landscape "thirty to fifty miles." When the "Big Blowup" subsided, some 1.22-1.62 million hectares (3-4 million acres) had burned, half a dozen towns had been overrun, and 85 lives lost (78 firefighters).

Around 0100 on August 22 the wind abruptly changed direction, relative humidity rose, and the fires ceased to spread. On the evening of the 23rd, a light rain (with some snow) dampened burning. Then the cycle once more repeated itself, though on a much muted scale. The fuels dried and fires spread until a drenching rain on Aug. 31 ended the fire season.

Several factors contributed to the dimensions of the "Big Blowup" of August 20-21. The fuels were dry, everything that was ignited burned, and spot fires were easily started. The southwest winds brought not moisture but desiccating desert air. The intensity of the wind reflected synoptic conditions associated with a dry, rapidly moving cold front that had an unusually strong pressure gradient. And the pre-existing fires were not only abundant but also large. Especially in the backcountry, many fires had escaped detection and control altogether. The lightning starts of July 23 and the small blowup of August 10 meant that a significant number of relatively large fires were burning when the gale winds of August 20 struck.

Koch claims that the 1910 fires involved 1,736 fires, of which 223 were set by lightning. But it is not clear whether these were the fires associated with the "Big Blowup" (that is, essentially the fires started or burning by the July 23 storm), or whether this number represents the total fire starts over the course of the entire season. Elsewhere Koch (and others) remark that 3000 fires had been attacked by mid-July. Either way, only 65 fires were large enough to be entered on the map of the 1910 fires. The map showed 50 fires less than 32,400 hectares (80,000 acres), 5 between 48,000 and 65,000 hectares (120,000 and 160,000 acres), and 10 fires greater than 73,000-81,000 hectares (180,000-200,000

acres). The gaps between these clusters suggest that these groups represent different "fire busts" and that the larger fires represent the older fires. The biggest population of fires probably represents the two "busts": the July 23 outbreak and assorted other starts associated with the August 10 and August 20-21 blowups. The middle group likely included fires that predated the July 23 bust or that escaped confinement as a result of weather associated with the July 23 storm. Although this group constitutes only one-tenth the number of fires of the first group, it accounts for probably half as much burned area. The last group of 10 fires—most of them in the 90,000-97,200 hectare range—represent fires that perhaps began early in the season deep in the backcountry, escaped detection or control until they became unmanageable, and made the extraordinary runs that made the "Big Blowup" so memorable. The largest 10 fires accounted for nearly two-thirds of the total area burned. The largest fires probably experienced three separate episodes of accelerated activity.



Size Distribution of 65 major fires involved in the "Big Blowup" of 1910. Derived from Koch map.

(A better map of the 1910 fires (1926) has since been located by Steve Pyne. Copies of both maps are attached.)

Taken from:

Pyne, Steve and Phil Omi. 1986. Wildland fires and nuclear winters—Selected reconstructions of historic large fires. Technical Report prepared for the Defense Nuclear Agency. DNA-TR-85-396. 162 p.

8/13/00, PLA

Sundance Fire, 1967

The Sundance Fire most probably resulted from a lightning storm on August 11. The summer had been abnormally dry and the fire load heavy. Five fires were started by the storm in the vicinity of Sundance Mountain in Idaho. Four were suppressed at a small size. The fifth, the Sundance Fire, was detected on august 23. The fire was contained, but not mopped up, at 14 hectares by the next evening. Six days later, on the evening of August 29 (2200 hours), the fire made a downhill run—burning as a combination surface and crown fire, growing to over 810 hectares, and spotting up to 0.8 km ahead of the flaming front. Nighttime inversion winds and northeast gradient winds combined to drive the fire to the southwest. On August 31, winds began to shift to the southwest in advance of an approaching weather system. By the morning (0700 hours) of September 1, the fire had burned approximately 1,620 hectares. For the remainder of the morning the fire was active but not unusually intense.

Around 1300 hours the fire picked up vigor. Within the space of the next 9-10 hours, driven by powerful southwesterly winds, the Sundance Fire staged a remarkable run that took it 26 air-kilometers (16 miles) from its point of origin. Approximately 93% of the total fire area was burned during the major run.

Universally dry fuels, the product of summer drought; abnormally low fine fuel moisture, the result of 72 hours of low relative humidity; increasing ambient winds and instability in the lower atmosphere, manifestations of an approaching weather system; a suitable array of fuels, some natural and some the aftermath of logging (slash and conifer reproduction)—all contributed to a veritable explosion of fire.

The dominant meteorological considerations were the onset of strong winds and the prolonged period of low relative humidity that for 3 days had preceded the run. A strong pressure gradient existed regionally. The wind regime was neither simple nor obvious. Finklin (1973) concluded that "such sustained low-tropospheric speeds (<40 knots at 5,000 ft) in this area can be expected on an average of no more than 2 days in the June 15 through September 15 fire season." That the appearance of such winds coincided with the existence of a large zone of combustion accounts for both the intensity of the Sundance Fire run and the relative rarity of such events. Finklin's description of the meteorology of the Sundance fire corresponds remarkable well with Beals' account of the conditions surrounding the 1910 fires.

The end of the fire run was about 2200 hours, Sept. 1. Fuel continuity and loads diminished: more of the area had been logged over a longer period of time, less slash existed, and spot fires had burned out significant proportions of the fuel array (up to 60%) in advance of the flaming front without in tern merging into a new front or propagating further spot fires. Wind velocity decreased, although it was still adequate to drive a line fire. Relative humidity rose, and fine fuel

moisture elevated accordingly. This not only slowed forward rate of spread but also retarded further spotting.

Taken from:
Pyne, Steve and Phil Omi. 1986. Wildland fires and nuclear winters—Selected reconstructions of historic large fires. Technical Report prepared for the Defense Nuclear Agency. DNA-TR-85-396. 162 p.

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Tillamook Burn, 1933

During a two-week period, from August 14 to August 28, the great Tillamook fire of 1933 burned 108,135 hectares (26,207 acres) of predominately old growth Douglas-fir forest in the Coast Range of Oregon. The Tillamook complex made three runs, each of which corresponded to powerful east (foehn) winds. The third run accounted for 81,000 hectares (200,155 acres), 75% of the total area burned. The Gales Creek, Wilson River, and Trask River fires collectively make up the Tillamook Burn.

The fire was part of a regional complex of fires, most of them incendiary. Other fires that burned at the same time consumed as much as 40 to 400 hectares (99 to 988 acres), although most were held to less than one hectare (2.5 acres). Only the Tillamook Burn experienced exactly the right combination of conditions to become an extraordinary event.

The fire began on August 14 on Gales Creek Logging Company land. The region had experienced a steady drying since June 9. A small amount of rain had fallen on August 3-5, and relative humidity, while reaching minimums of 20-30% at inland stations, still exhibited a normal diurnal pattern that brought saturation during the evening. The summer had not been exceptionally droughty and the fire season was considered lighter than normal. For a few days prior to the start of the Tillamook Burn, however, the maximum relative humidity plummeted and temperatures reached record highs. Because of fire danger the Governor ordered closure of logging in several counties; but the order either did not reach the Gales Creek Logging Company in time or was temporarily ignored.

Dry fuel, notoriously combustible logging slash, and remoteness and ruggedness of the terrain all contributed to the intensity of the initiating fire and the difficulty of control. The fire propagated principally by long-range spotting. "It is not too strong a statement to say that the history of the Tillamook Burn is a history of the east winds that episodically rushed over the region." The winds not only determined the direction of fire spread and its intensity, but the critical fuel moistures of the fine fuels were determined by the dry east wind. Low fuel moisture, in turn encouraged spotting, by allowing even relatively small embers to ignite new fires. By persisting through the evening, east winds prevented any diurnal recovery of relative humidity or fine fuel moisture. When the east wind blew, the fire spread vigorously. Without it, marine air reinvaded the burn and the fire subsided.

The Tillamook fire burned within the rugged Coast Range of Oregon, and terrain affected virtually every component of the fire environment—wind, fuel, etc. It encouraged long- and short-range spotting. The terrain confined suppression efforts to the more accessible perimeters of the fires.

The three runs were August 14-15, August 20-22, and August 24-26. The third and major run of the fire was from 1600 on Aug. 24 to 1800 Aug. 26. The run accounted for 75% of the total area burned. Observers indicated a "pick up" period of about 12 hours (1800 Aug 24 to 0600 Aug. 25) and a "blowup" period of 36 hours (0600 Aug. 25 to 1800 Aug. 26). Of special interest is the mid-day of August 25 when the ambient winds diminished markedly and large-scale convective clouds appeared.

On August 27 most of the Burn experienced a "dead calm." Relative humidity increased. Scattered traces of rain fell on the evening of August 27; a light, soaking rain fell on August 28, then a heavy rain and fog. There was more rain on August 29 and flaming ceased.

Taken from:
Pyne, Steve and Phil Omi. 1986. Wildland fires and nuclear winters—Selected reconstructions of historic large fires. Technical Report prepared for the Defense Nuclear Agency. DNA-TR-85-396. 162 p.

8/13/00, PLA

Canyon Creek, 1988

The Canyon Creek Fire was initially a free-burning natural prescribed fire within the Scapegoat Wilderness of north-central Montana. The lightning-caused fire burned for 112 days through high elevation mixed conifer and lodgepole pine forests. During the life of the fire, six crown fire runs in excess of 4,000 acres occurred, the latest of which was during the burning period of September 6 and 7 which burned approximately 117,330 acres, 62% of the final size. The crown fire run burned through rugged mountainous terrain along an approximate 65 mile long fire line, covering a distance of abut 21 miles in 5.5 hours. The fire was declared controlled October 14 under a cover of snow. Final size was 188,071 acres. The Canyon Creek Fire exhibited some of the most severe fire behavior and rapid growth rates ever documented in the United States.

Reference:
Bushey, Charles L. 1991. Documentation of the Canyon Creek Fire. Final report, prepared for the Lolo National Forest. 85 p.

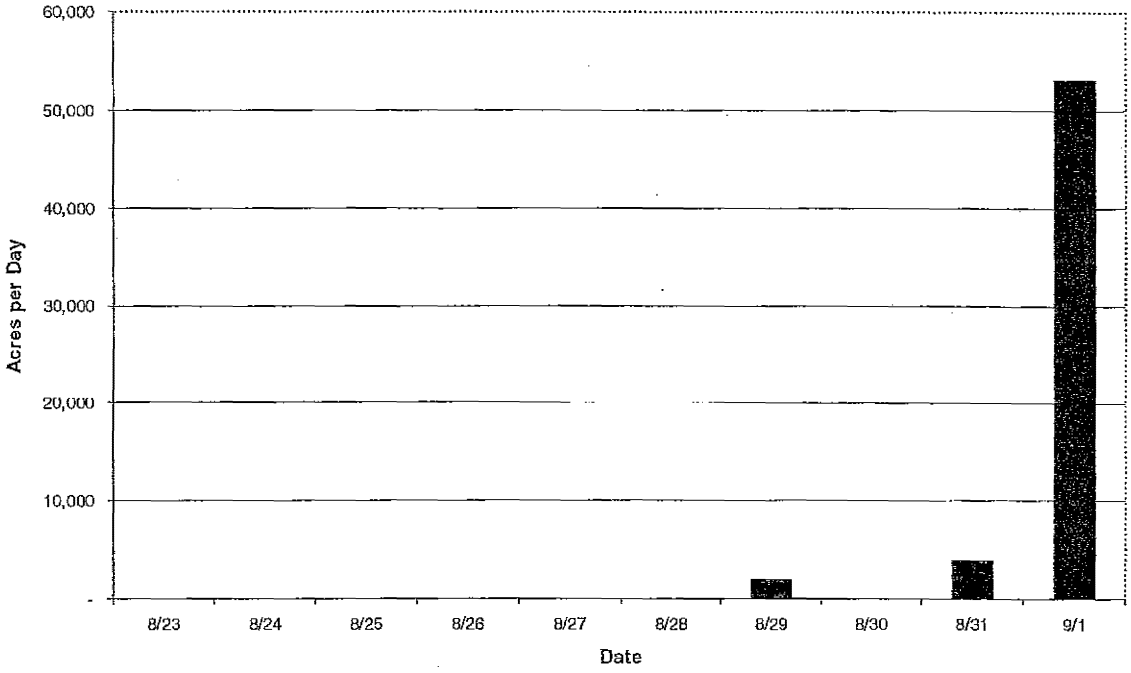
Yellowstone NP, 1988

In the summer of 1988, Yellowstone National Park and adjoining areas within the National Forests, commonly referred to as the Greater Yellowstone Area, experienced the most extensive forest fires seen in the Western States since the great Northwest fires of 1910.

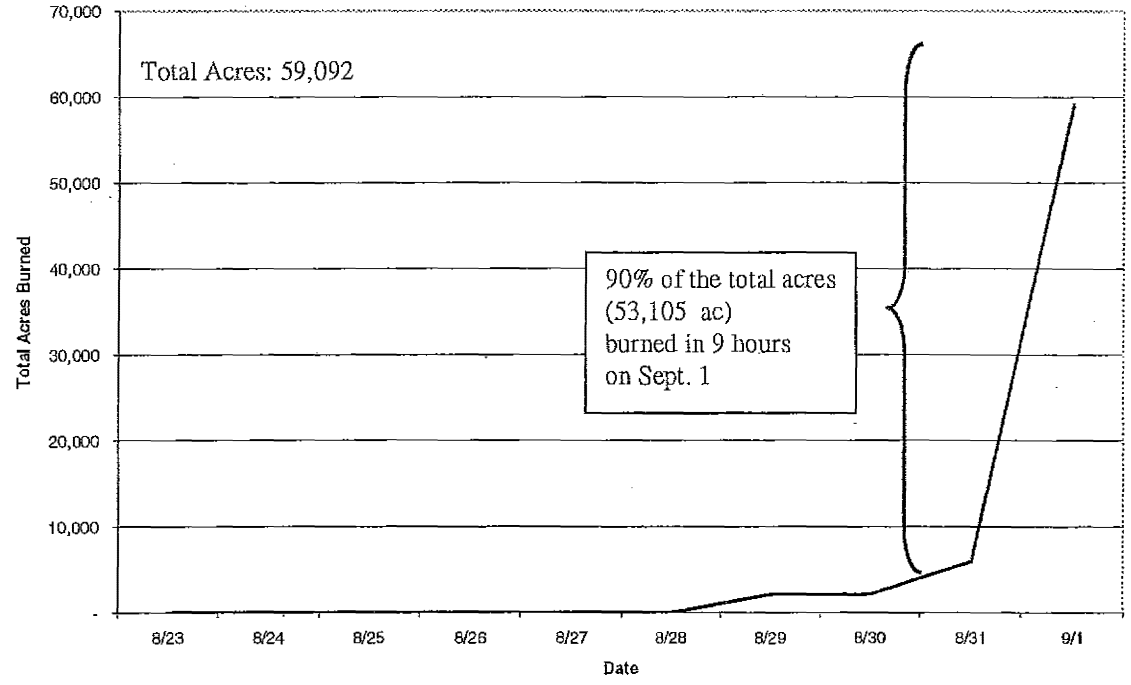
Initially, some of the fires within Yellowstone park were allowed to burn unimpeded, as provided in the Park's fire management plan. But when early summer rains did not materialize, the threat of drought necessitated that strong fire suppression measures be taken.

By July 24 all the prescribed natural fires had been declared wildfires.

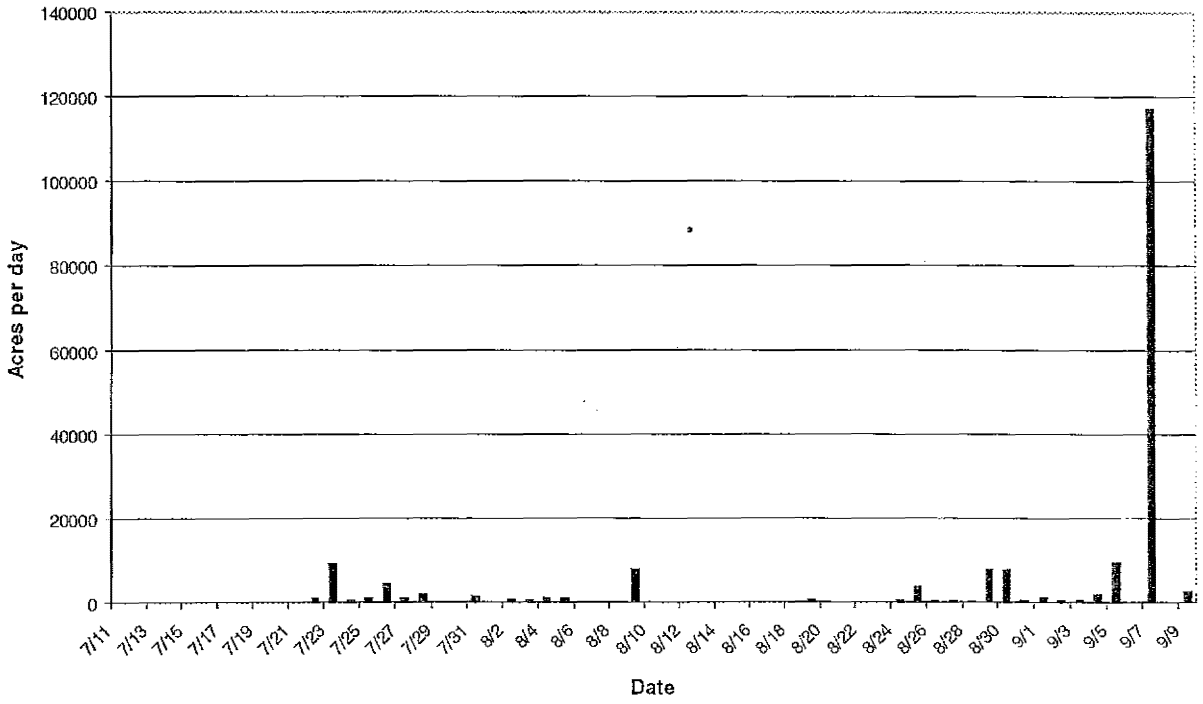
Sundance Fire, 1967



Sundance Fire, 1967



Canyon Creek Fire, 1988



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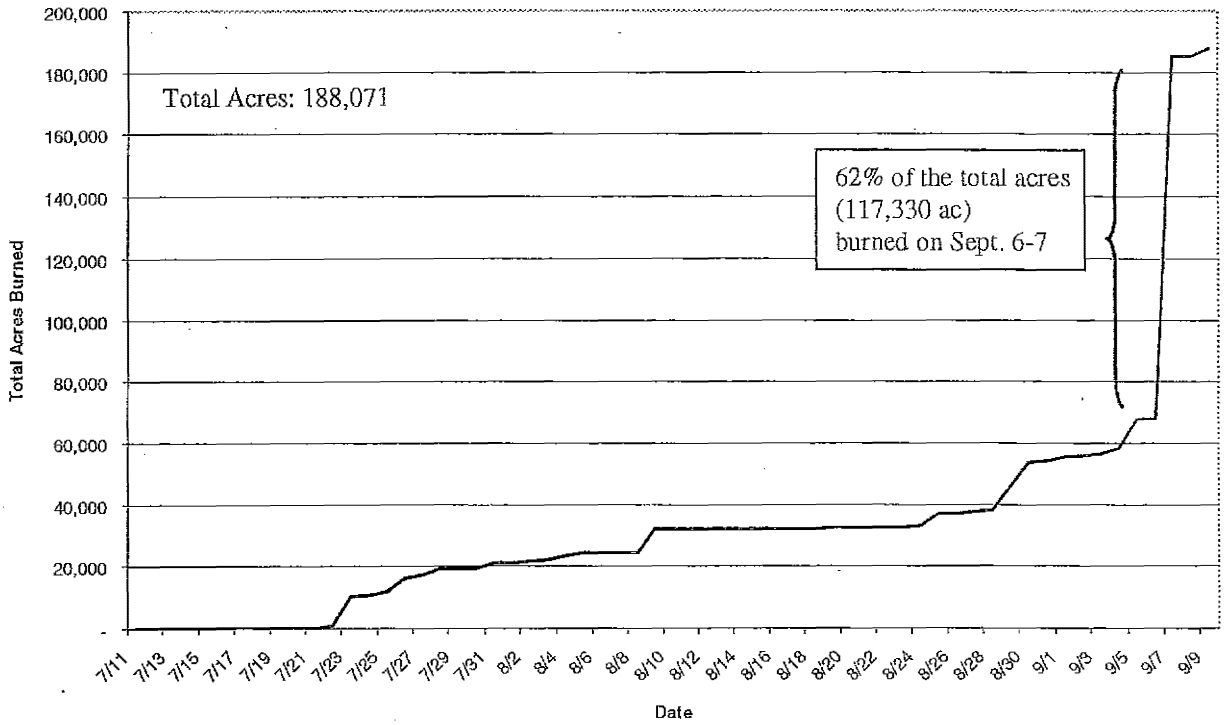
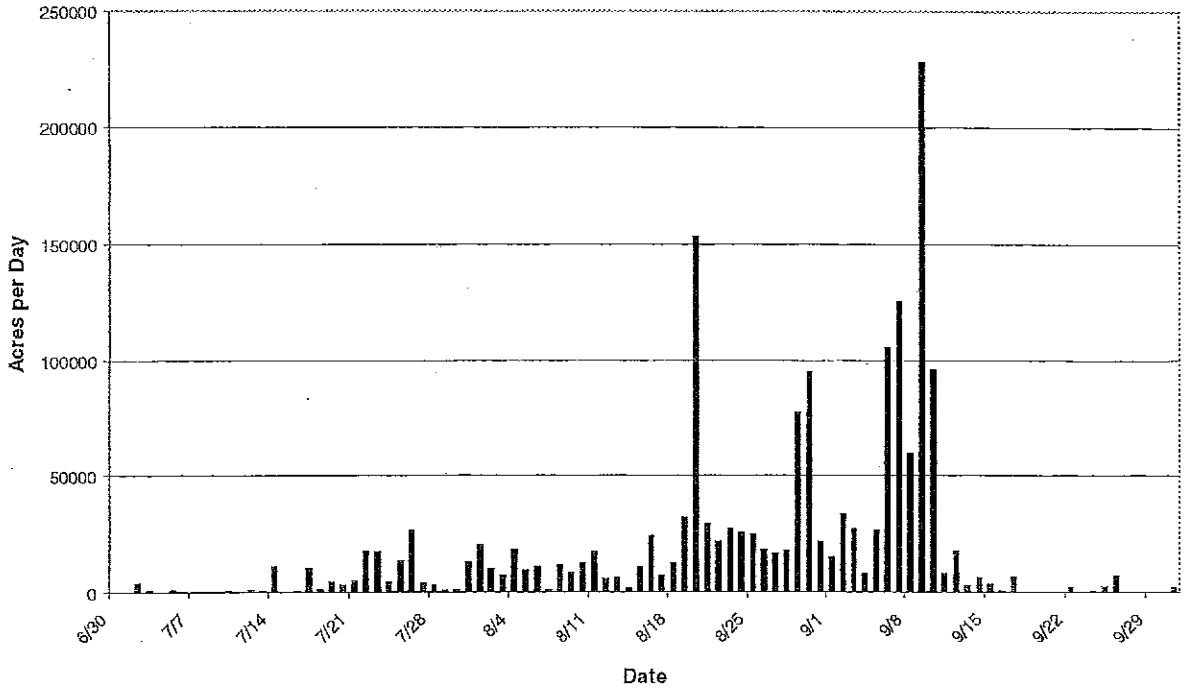
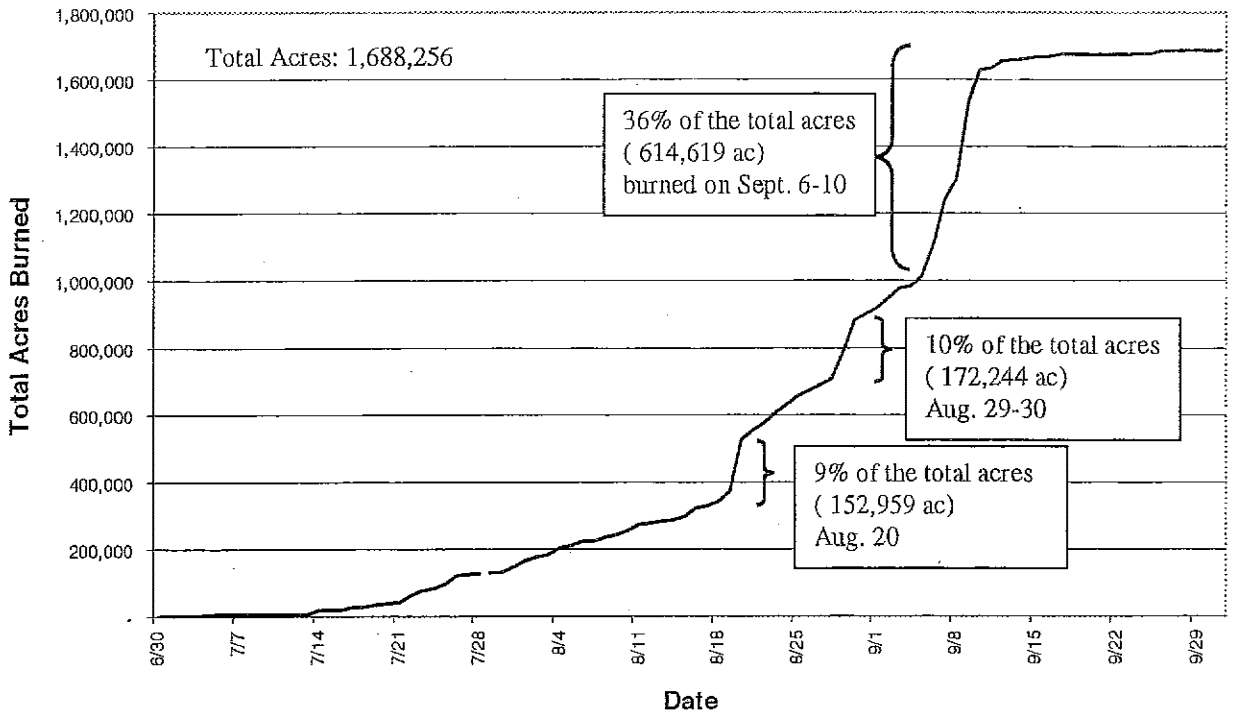


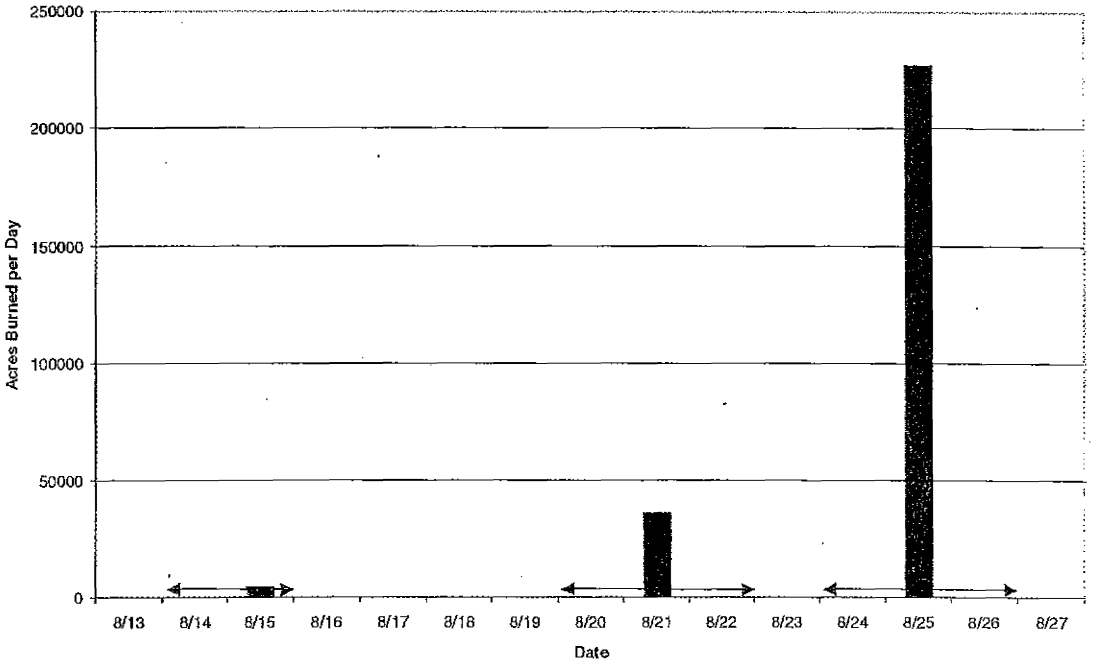
Yellowstone Fires, 1988



Yellowstone Fires, 1988



Tillamook Burn, 1933



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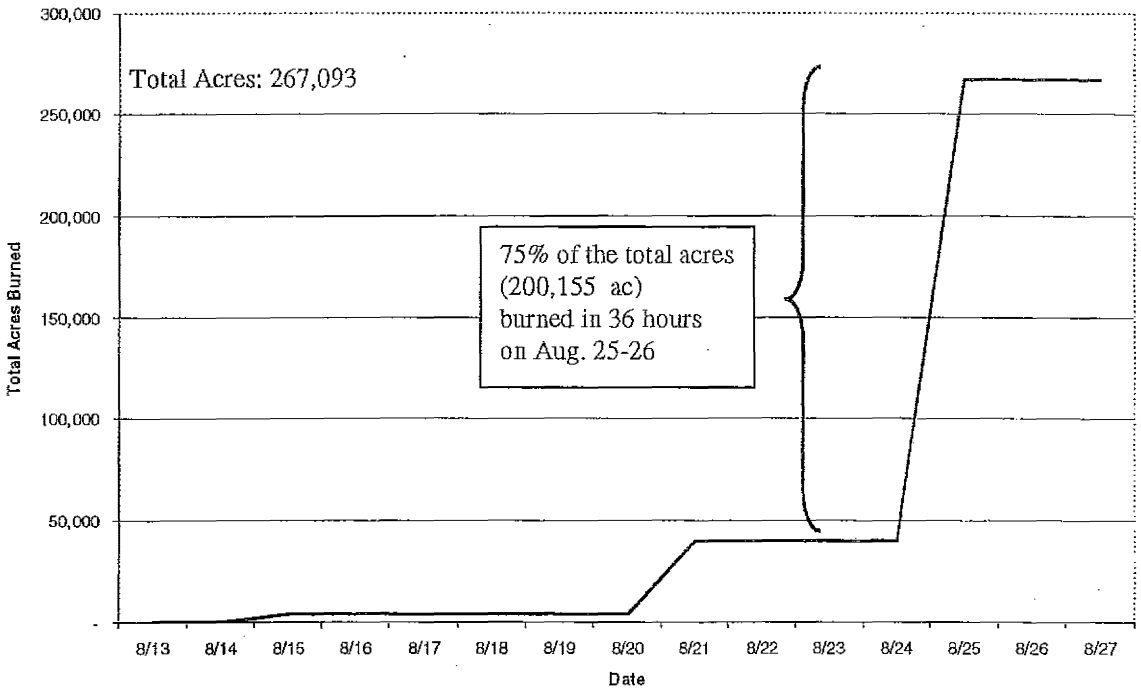


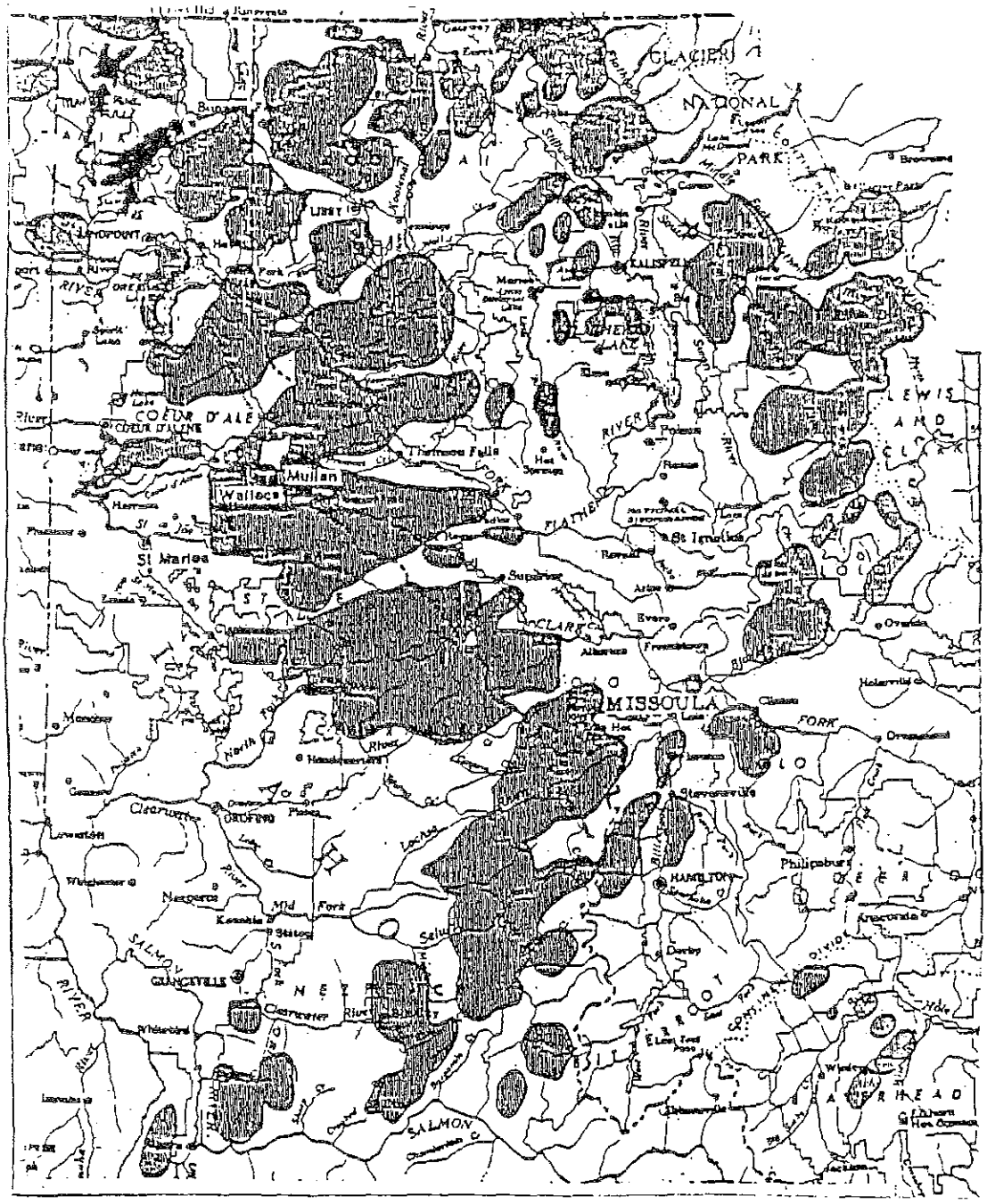
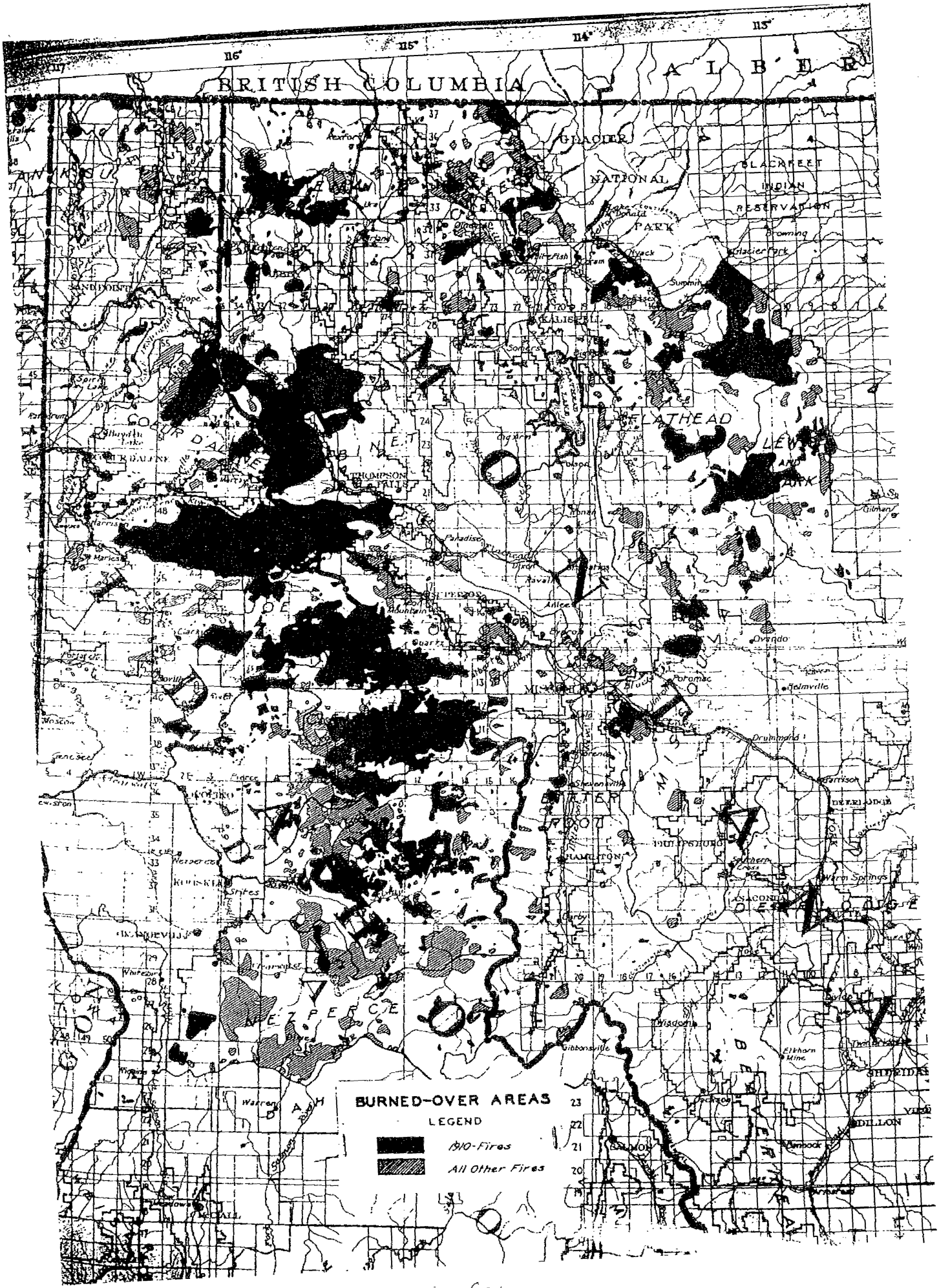
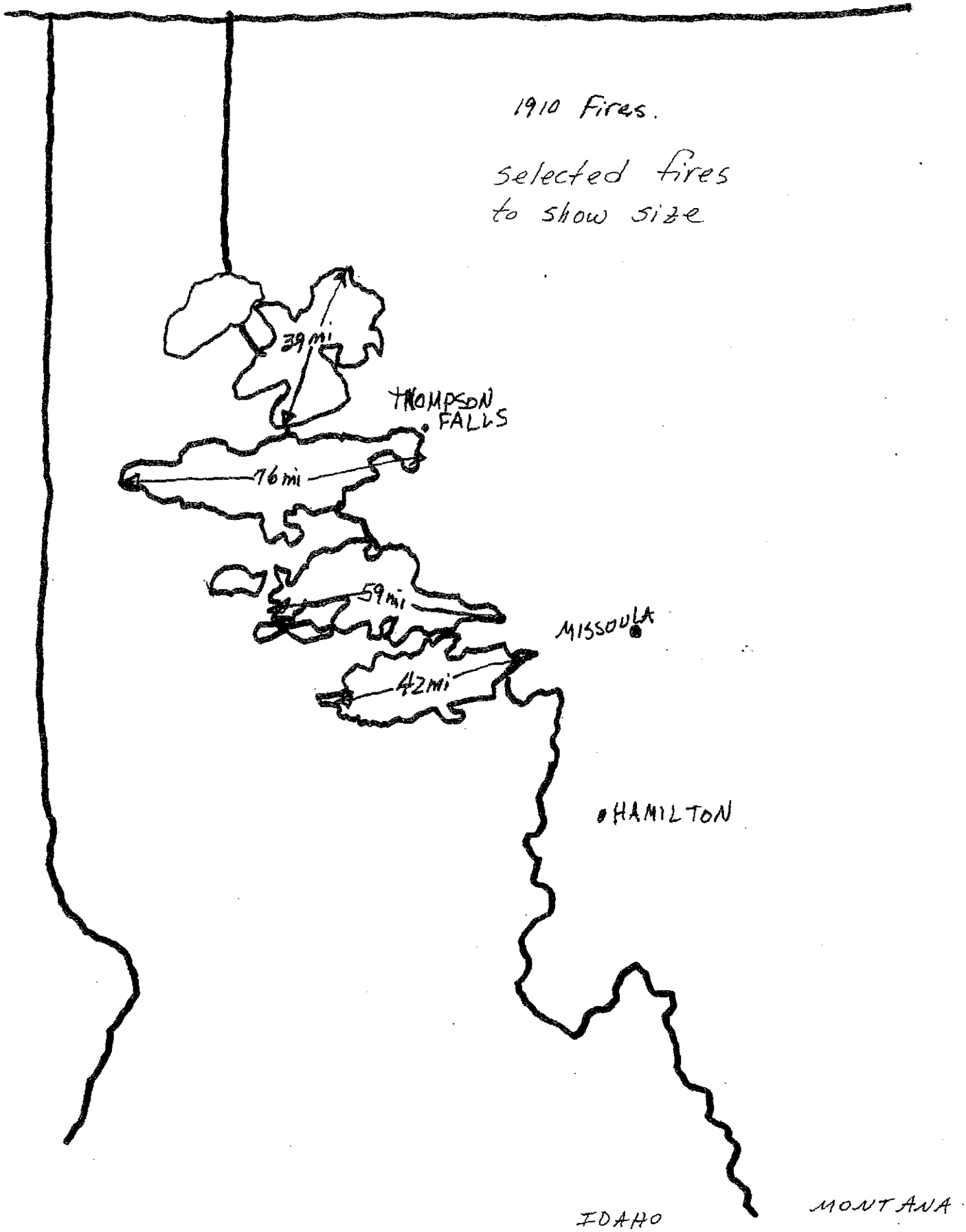


Figure 26. Map of the major 1910 fires in Region 1, U.S. Forest Service. Reproduced from Koch (n.d.) Source information presumably comes from fire reports filed after the 1910 season. The Sundance and Trapper Peak fires (1967) are indicated by arrows and are completely blacked in.



FOREST AREAS IN NORTHWEST MONTANA AND ADJACENT PARTS OF BRITISH COLUMBIA AND IDAHO SHOWING AREAS BURNED OVER IN 1910

FS. 1926


1910 Fires.
selected fires
to show size
39 mi
THOMPSON FALLS
76 mi
59 mi
MISSOULA
42 mi
HAMILTON
IDAHO
MONTANA

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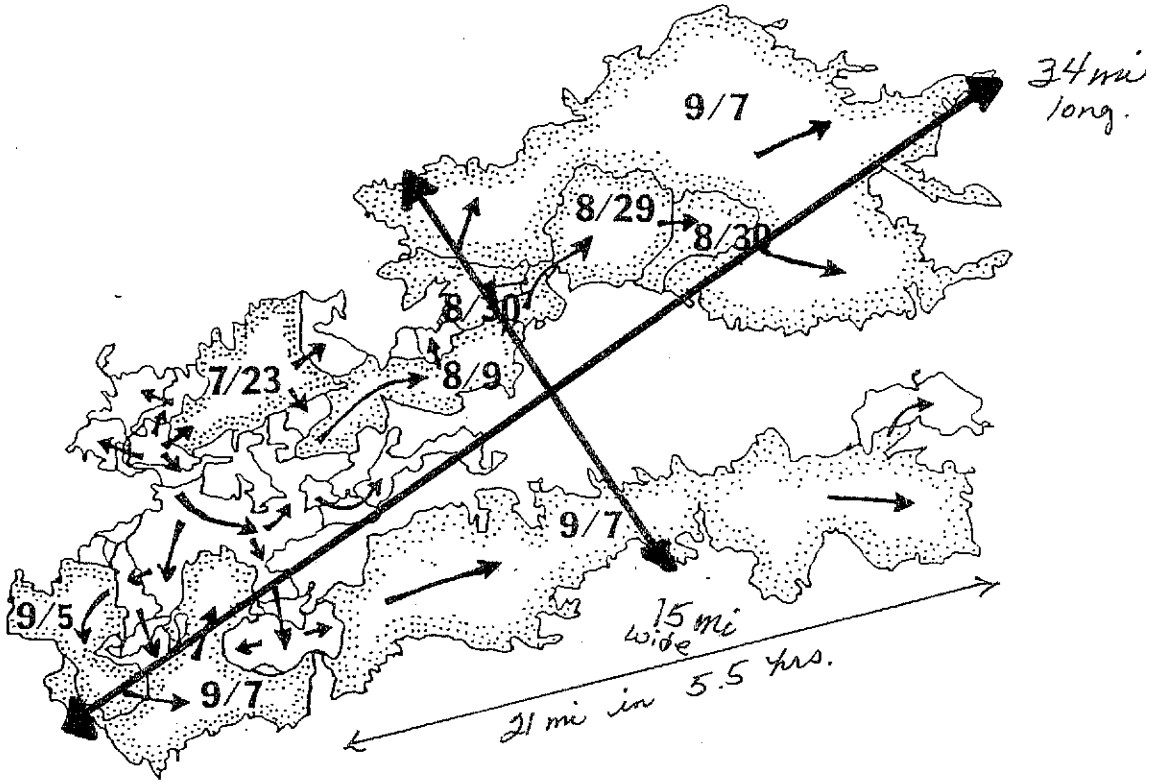
Sundance 1967 Fire

The maps for the Sundance Fire, Canyon Creek Fire, and a selected 1910 fire are printed here at the same scale for comparison of size.

1" = 5.9 mi

Canyon Creek 1988 Fire



1" = 5.9 mi

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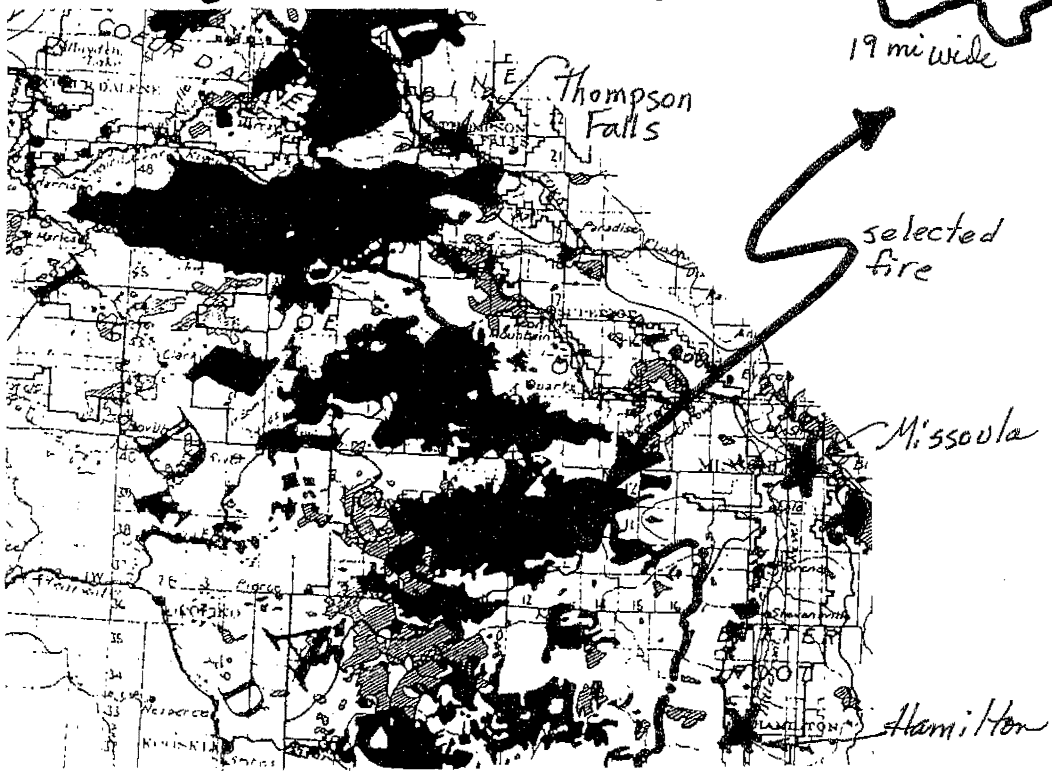
A 1910 Fire

44 mi long

19 mi wide

1" = 5.9 mi



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